



UNITED STATES PATENT AND TRADEMARK OFFICE

AmJ

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/839,910	04/19/2001	Arch Robison	042390.P11195	2234

7590 01/13/2005

Sanjeet K. Dutta
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025-1026

EXAMINER

KANG, INSUN

ART UNIT PAPER NUMBER

2124

DATE MAILED: 01/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/839,910	Applicant(s) ROBISON, ARCH	
	Examiner Insun Kang	Art Unit 2124	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This action is in response to the amendment filed 8/23/2004.
2. As per applicant's request, claims 1, 2, 5, 7-9, 12, 14-16, 19, and 21 have been amended. Claims 1-21 are pending in the application.

Specification

3. Regarding the objection to the specification due to the missing brief summary, the applicant refuses to add the brief summary of invention because a brief summary of invention is not required. In response, 37 CFR §1.73 also does not state that Examiner should not object a specification when the brief summary of invention is not present (i.e. if not applicable). Therefore, the objection to the specification is maintained.

Claim Rejections - 35 USC § 112

4. Regarding claims 6, 13, and 20, applicant's argument is persuasive and claims 5, 7, 12, 14, 19, and 21 have been amended. Therefore, the rejection to claims 5-7, 12-14, and 19-21 has been withdrawn.

Double Patenting

5. Terminal Disclaimer under 37 CFR § 1.321 filed 8/23/2004 has been acknowledged.

Claim Rejections - 35 USC § 102

Art Unit: 2124

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-21 are rejected under 35 U.S.C. 102(e) as being anticipated by Cheng et al. (US Pub. No. 2002/0010911) hereinafter referred to as "Cheng."

Per claim 1:

Cheng discloses:

-analyzing each routine, of a software program having a plurality of separately compilable routines, to create a plurality of local side-effect lattice problems for each routine (i.e. "In compiling a program, the present algorithm first analyzes each function in the program as an isolated compilation unit... This stage of the algorithm, the **intraprocedural phase**, will summarize the intraprocedural behavior of a function...including how it can affect memory accesses in the caller and callee functions, and how its memory accesses can be affected by the caller and callee functions," pg 1, 0008)

-merging the local side-effect lattice problems to create a global side-effect lattice problem (i.e. "In the **interprocedural stage**, bottom-up propagation of summary transfer functions along the call graph is performed," pg 2, 0027)

Art Unit: 2124

as claimed.

Per claim 2:

The rejection of claim 1 is incorporated, and further, Cheng discloses:

- computing a global solution to the global lattice problem (pg 2, 0025) and splitting the global solution into local solutions (i.e. "top-down propagation of function names along the partially resolved call graph is also conducted, since some indirect call-sites may receive concrete function names through parameters... The aliases among formal parameters are then calculated after top-down propagation of concrete values along the complete call graph," pg 2, 0027)

as claimed.

Per claim 3:

The rejection of claim 2 is incorporated, and further, Cheng discloses:

- determining for each routine, whether a pointer parameter within the routine is used to write to or read from a storage device ("To accommodate their **side-effects** appropriately in the interprocedural pointer analysis stage, each library function with side-effects are written with template statements," pg 11, 0107; If a function pointer is resolved by accommodating **the side-effects of the callees**, re-evaluating the access path of the indirect call-site will find the propagated function name pg 10, 0101; pg 11, 0108; pg 8,0081; pg 1, 0008; pg 6, 0073) as claimed.

Per claim 4:

Art Unit: 2124

The rejection of claim 3 is incorporated, and further, Cheng discloses:

- determining for each routine whether the pointer parameter is used to derive a return value of the routine (i.e. "the summary transfer function of **memcpy** will include points-to relation (**f_1_mem***, **f_2_mem****), which will be processed in the interprocedural stage to expose the effect of the hidden pointer assignment in memcpy," pg 11, 0108; pg 5, 0045; pg 6,0060) as claimed.

Per claim 5:

The rejection of claim 4 is incorporated, and further, Cheng discloses:

- computing a lattice value associated with each of the pointer parameters, wherein the lattice value comprises one or more of a return, write, and read effect (i.e. "Pointer assignments in each function are analyzed by their lexical order to calculate the points-to relations," pg 6, 0071; 0027; "The aliases among formal parameters are then calculated after top-down propagation of concrete values along the complete call graph (pg 2, 0025-0027) as claimed.

Per claim 6:

The rejection of claim 5 is incorporated, and further, Cheng discloses:

- providing the lattice values to an interprocedural analysis solver to optimize compilation of the software program (i.e. abstract; Pg 2,0025-0028) as claimed.

Per claim 7:

Art Unit: 2124

The rejection of claim 6 is incorporated, and further, Cheng discloses:

-representing the local side-effect lattice problems as directed graphs having edges and vertices, wherein each edge has an associated monotone transfer function; each vertex has a vertex value, wherein the vertex value is one of formal parameter, implicit parameter, local pointer variable, or gate parameter; and a subset of the vertices is marked with the lattice values (i.e. pg 3, 0027-0029; pg 8, 0086; pg 11, 0102-0103).

Per claims 8-14, they are the computer-readable medium versions of claims 1-7, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-7 above.

Per claims 15-21, they are the system versions of claims 1-7, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-7 above.

8. Claims 1-21 are rejected under 35 U.S.C. 102(e) as being anticipated by Archambault (US Patent 6,173,444).

Per claim 1:

Archambault discloses:

- analyzing each routine, of a software program having a plurality of separately compilable routines, to create a plurality of local side-effect lattice problems for each routine (i.e. "intraprocedural information about pointer variables referenced in each function of the program is gathered and saved in a data structure called the pointer alias

Art Unit: 2124

graph,” col 3 lines 5-67 and col 4 lines 1-12; “the initial intraprocedural analysis phase to develop a pointer alias graph for each function for later use in the middle interprocedural analysis phase,” col 4 lines 34-39; “a local scalar data dependence graph for each basic block of the program. This local analysis is used to form a global data dependence graph that shows data dependencies in the context of a control flow graph within a single function that can be used for later optimizations in the compiler,” col 1 lines 40-47)

-merging the local side-effect lattice problems to create a global side-effect lattice problem (i.e. “a middle phase in which the pointer alias graphs from all the compilation units for the program are combined to form a universal pointer alias graph,” col 4 lines 1-13; “A definition nodes (from the accumulated graphs) for each pointer variable are merged into a single definition node, and the alias sets of each of the nodes are combined(union) to form the universal alias set for a specific pointer variable,” col 7 - lines 24-45).

Per claim 2:

The rejection of claim 1 is incorporated, and further, Archambault discloses:

-computing a global solution to the global lattice problem (i.e. “utilizes interprocedural analysis, a second pass performed at link time, in which the collected information is merged and used to compute an interprocedural solution,” col 4 lines 19-40)
-and splitting the global solution into local solutions (“alias sets are propagated for all pointer variables in the universal graph,” col 7 lines 35-67; “Each of the files is

Art Unit: 2124

recompiled performing the intraprocedural algorithm using the final universal pointer alias graph as input," col 8 lines 7-16).

Per claim 3:

The rejection of claim 2 is incorporated, and further, Archambault discloses:

- determining for each routine, whether a pointer parameter within the routine is used to write to or read from a storage device (i.e. col 7 lines 33-67)

Per claim 4:

The rejection of claim 3 is incorporated, and further, Archambault discloses:

- determining for each routine whether the pointer parameter is used to derive a return value of the routine (i.e. col 8 lines 20-67)

Per claim 5:

The rejection of claim 4 is incorporated, and further, Archambault discloses:

- computing a lattice value associated with each of the pointer parameters, wherein the lattice value comprises one or more of a return, write, and read effect (i.e. col 5 lines 52-67 and col 6 lines 1-39 and 60-67)

Per claim 6:

The rejection of claim 5 is incorporated, and further, Archambault discloses:

- providing the lattice values to an interprocedural analysis solver to optimize compilation of the software program (i.e. "transitive closure is performed on the universal pointer alias graph to produce a reduced graph containing the list of objects that each pointer variable can point to. In the final phase, all the files are re-compiled using the universal pointer alias graph as input," abstract; col 9 lines 18-23) as claimed.

Per claim 7:

The rejection of claim 6 is incorporated, and further, Archambault discloses:

- representing the local side-effect lattice problems as directed graphs having edges and vertices (i.e. "all of the pointer graphs developed through the intraprocedural pass," col 7 lines 24-67 and col 8 lines 1-16) wherein each edge has an associated monotone transfer function (i.e. col 7 lines 24-67 and col 8 lines 1-16) each vertex has a vertex value, wherein the vertex value is one of formal parameter, implicit parameter, local pointer variable, or gate parameter; and a subset of the vertices is marked with the lattice values (i.e. col 7 lines 24-67 and col 8 lines 1-16) as claimed.

Per claims 8-14, they are the computer-readable medium versions of claims 1-7, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-7 above.

Per claims 15-21, they are the system versions of claims 1-7, respectively, and are rejected for the same reasons set forth in connection with the rejection of claims 1-7 above.

Response to Arguments

9. Applicant's arguments filed 8/23/2004 have been fully considered but they are not persuasive.

Per claim 1:

The Applicant simply states that Cheng and Archambault do not disclose the limitation, "creating lattice problems for separate routines."

In response, the Applicant fails to discuss the references applied against the claims, specifically explaining how the claims avoid the references or distinguish from them and to point out disagreements with the examiner's contentions.

Further, Cheng and Archambault disclose an element of a lattice domain such as the merge function that is the lattice meet operation for the greatest lower bound (Cheng, i.e. "The trimmed summary behavior will be merged into each function to guide code optimizations, page 11 paragraph 0106; Archambault, i.e. "the collected information is merged and used to compute an interprocedural solution," col. 4 lines 20-33). The data-flow information is drawn from a lattice of possible data-flow information. After the merge, the best conservative information possible can be computed (Archambault, i.e. "Transitive closure is performed and the resulting reduced graph is used as input to a second interprocedural pass...All definition nodes ...for each pointer variable are merged into a single definition node, and the alias sets of each of the nodes are combined (union) to form the universal alias set for a specific pointer variable," col. 7 lines 30-45; Cheng, i.e. "the bottom-up and top-down propagations need to be performed iteratively until a fixed point is reached. The aliases among formal parameters are then calculated after top-down propagation of concrete values along the complete call graph," page 2, paragraph 0027). Therefore, Cheng and Archambault disclose the lattice theoretic framework for the whole program interprocedural data-flow

Art Unit: 2124

analysis, in view of the broadest reasonable interpretation above. Accordingly, the rejection of claim 1 is considered proper and maintained.

Per claims 8 and 15:

The applicant states that these claims are patentable for the reasons set forth in connection with claim 1. As shown above, the rejections of claim 1 by Cheng and Archambault were maintained, and accordingly, the rejections of claims 8 and 15 are also maintained.

Per claims 2-7, 9-14, and 16-21:

The applicant states that the claims are allowable as being dependent on allowable base claims. As shown above, the rejections of the independent claims 1, 8, and 15 by Cheng and Archambault are maintained, the argument that claims 2-7, 9-14, and 16-21 are allowable as being dependent on allowable base claims is considered moot. Accordingly, the rejections of claims 2-7, 9-14, and 16-21 are proper and maintained.

Conclusion

10. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not

Art Unit: 2124

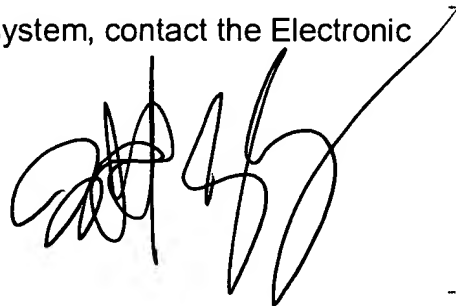
mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Insun Kang whose telephone number is 571-272-3724. The examiner can normally be reached on M-F 9:30-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kakali Chaki can be reached on 571-272-3719. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Examiner I. Kang
1/3/2005

A handwritten signature in black ink, appearing to read 'TODD INGBERG', with a long, sweeping horizontal line extending to the right.

TODD INGBERG
PRIMARY EXAMINER